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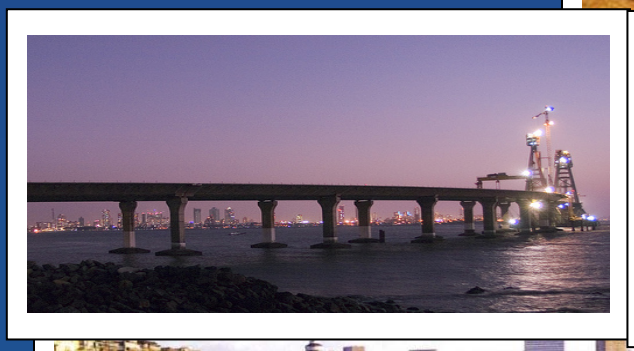

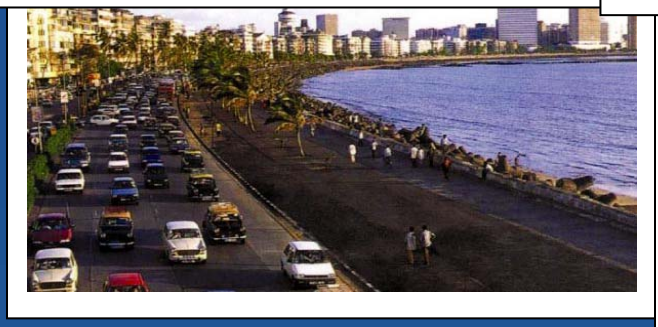

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About the Journal

The concerns for the sustainability of natural and environmental resources have arisen due to their misuse or excessive use by the mankind. While economically weaker sections of the society are compelled to overuse these resources for meeting their basic needs, prosperous and rich people are overexploiting them due to their never satiable greed. Many firms and individuals want to maximize their economic benefits in the least possible time. But the carrying capacity of the nature is limited and with ever-increasing needs or greed of people, it may not be able to sustain an enhanced pressure. We are facing a challenge of optimizing the use of the currently available resources to meet the needs of the present generation without compromising on the requirements of the future generations. To achieve this, it is imperative that we utilize our natural and environmental resources in such a way that our fragile ecosystem does not suffer an irreversible damage. This urgently requires evolving some innovative methods that provide sustainable solutions to the ever growing problems of depletion and degradation of resources.

The objective of publishing the International Journal for Sustainable Innovations (IJSI) is to highlight any innovative approach, research or action by various stakeholders including the academicians, researchers and policy makers. It focuses on issues related to energy, environment, urbanization, infrastructure, industrialization, rural development, and related sectors, the consequences of which are the major concerns for a sustainable future. Thus, IJSI is an inter-disciplinary journal that follows three pillar approach for the sustainability i.e. social, economic and environmental.

The Editorial Board of the IJSI invites contributions from all, in the form of articles, papers, books, monographs, policy reports, etc., for review and publication. All contributions submitted to IJSI will be peer reviewed by atleast two anonymous referees and published in the journal only after obtaining a favorable report from the referees and the opinion of the editors of the journal. Authors should take full responsibility of the originality of their contributions and will be required to transfer the copy right of their contributions to the IJSI.

The frequency of the journal is one issue per year, which, in due course may be increases to two or four issues per year. The journal is planed in three forms of publication i.e. print version, CD version and online version. subscription to the journal are open to all at a very attractive rates and discounts are available to academic and research organizations, charitable institutions, students and NGOs.

Format for the papers

The template for the format of the paper to be submitted to the IJSI is available at (http://www.igidr.ac.in/ISSF-2010), which will be applicable for all the three versions of the Journal. However, while CD and online version can accept the colored fonts for figures and table, for the print version only black and white fonts will be accepted. Thus, if contributors want to publish their papers in all the three versions, final copy of their contributions must be submitted in black and white fonts also.

About the Editors

B. K. Sahu is Emeritus Professor for Life at the Indian Institute of Technology Bombay (IITB), Mumbai, India. IITB is a premier institute of the Government of India.

Prof. Sahu completed his Ph.D. in Geology (major) and Statistics (minor) at the University of Wisconsin, Madison, USA in 1962, holding the prestigious TCM Fellowship. His work experience of over 47 years includes positions of Lecturer in Geology at Punjab University, Chandigarh, Assistant Professor and Head of the Department of Geology at the National Institute of Technology, Rourkela, Professor of Geology at IITB, Head, Earth Sciences Department, IITB, and CSIR Emeritus Professor at IITB.

Prof. Sahu has served as an Advisor in many National Committees of Central and State Governments, Universities, Institutes and private organizations. Some of them are Oil and Natural Gas Corporation and Department of Science and Technology. He is a Life Member of AAPG (USA) since 1960, an Emeritus Member of SEPM (USA) since 1966, and a Founder Member and Life Member of IAMG (USA) since 1968 and an active Member of Institute of Mathematical Statistics(USA) since 1995. He is also a Life Fellow of many Geological and Mineralogical Societies in India since 1962 and President of ISLCA.

Some of the major achievements of Prof. Sahu include the Prestigious S.S. Bhatnagar Prize (1980) in Earth Sciences from CSIR (New Delhi); Silver Medal from SGAT, Bhubaneshwar (1981) for Mineral Deposit Modeling.

Prof. Sahu has published a large number of research papers both in national and international journals of repute in the fields of groundwater and pollution, environment, sedimentology, mathematical geology, mineral resources modeling, computer applications in geology, porous media, stereology, etc.

Prof. Sahu's research interests include Environmental Pollution Remediation; Mathematical Modeling; Ore Deposit Modeling; Granular & Fractured Porous Media Modeling; Clastic Sedimentology; Oil & Gas Exploration; Coal Ash Disposal; Tectonics of the Himalayas; Computer Applications in Earth Sciences.

Vinod K. Sharma is a Professor at Indira Gandhi Institute of Development Research (IGIDR), Mumbai, India. IGIDR is an Advanced Research Institute of the Reserve Bank of India and a deemed University with A++ rating.

Prof. Sharma completed his Ph.D. in Environmental Engineering (Air Pollution) from the Indian Institute of Technology Bombay, Mumbai, India in 1992. His work experience of over 27 years includes positions of Civil Engineer, Irrigation Department, Govt. of Rajasthan, Lecturer in the Board of Technical Education, Govt. of Rajasthan, Assistant Professor of Civil and Environmental Engineering at the University of Jodhpur, Rajasthan, Associate Professor at IGIDR, and Professor and Head in the Department of Postgraduate Studies and Research at the SNDT Women's University, Mumbai. He has served as the Dean of the IGIDR with overall responsibility of Institute's academic programs and Associate Dean in the capacity of the Convener of Students Welfare and Grievance Committee. Prof. Sharma has wide range of international experience and has worked at the World Bank, Washington D.C., USA, and the National Institute of Environmental Studies, Japan.

Prof. Sharma has completed several research and consultancy projects for international organizations including the UNDP, UNEP, UNCTAD, UN-ESCAP, CREED, the World Bank, ICEF, SICI, JBIC, APO, AIST, JETRO, ERIA and the Japan Environment Agency; and for Indian organizations including the Ministry for Environment and Forests, India, Central and State Pollution Control Boards and the Planning Commission of India.

Prof. Sharma has a large number of research publications, which include research papers in peer reviewed International and Indian journals, newspaper and magazine articles, books and policy reports. He has been on the editorial board of international journals published from Germany, The Netherlands, USA and Japan. Prof. Sharma's areas of interest include energy, environment and sustainable development issues. Some of the focus areas are Local Pollution of Air, Water and Solid Waste, Life Cycle Assessment, Climate Change Issues, Trade and Environment, Natural Resource Accounting and New and Renewable Energy.

Journal's Editorial Board Members

Akira Hibiki is a Head of Environmental Economics & Policy Section in Social and Environmental Systems Division at National Institute for Environmental Studies in Japan. He is also an affiliated faculty fellow, Science, Technology, and Environment Research Group, College of Urban Planning and Public Affairs at the University of Illinois at Chicago and a member of the advisory board for the Biomass Nippon (Japan) Strategy of the Japanese Government.

Dr. Hibiki's research focuses on economic analysis of environmental policy. Currently he is conducting empirical studies on voluntary approaches, environmental management in the firm, effectiveness of the waste management policy, effects of the trade on the environment and household's water demand. His research has been published in Journal of Environmental Economics and Management, Land Economics, Policy Science and Journal of Environmental Planning and Management.

Alain Dubreuil obtained a bachelor in chemistry from the Université de Montréal and a M.Sc. A. and a Ph. D. in metallurgical engineering from École Polytechnique de Montréal. He is a member of the Society of Environmental Toxicology and Chemistry (SETAC) since 1997. He is a member of the Canadian Standards Association Technical Committee on Life Cycle Assessment (LCA) since 2000 and he chaired of the SETAC North America LCA Advisory Group from 2002 to 2004.

Dr. Dubreuil was the technical chairman for Conference of Metallurgists of the Metallurgical Society of CIM (Canadian Institute of Mining, Metallurgy and Petroleum)in 2000. In 2006, he co-chaired the annual meeting of SETAC North America in Montréal. Since 2003 to 2008, he represents Canada at the governing body of the United Nations Environment Programme / SETAC Life Cycle Initiative. He participated in the working group on metals of the United Nations Environment Programme and International Panel for Sustainable Resource Management. He is participating on several international committees in an effort to drive the sustainability of natural resources/materials and specially metals. He holds four patents. He has been the editor of a book published by SETAC on LCA and metals. He published a number of journal articles on metallurgy and on LCA. He also serves as peer reviewer for the International Journal of LCA.

Ana Lorena Quiros Lara completed her Master in Engineering from Stanford University, California. Master in Sciences from Stanford niversity, California and Civil Engineering degree from the University of Costa Rica. In 1997, Ms. Quiros founded ECO GLOBAL and since then has been in charge of all aspects of the firm. ECO GLOBAL is a totally independent private consulting firm dedicated to assist the private and government sectors on sustainable development issues.

Ms. Lara is associated with several professional bodies such as CFIA Costa Rica; Former President and current member of the Committee of the UPADI (Pan-American Union of Engineers); Currently in charge of the Coordination for the Sustainable Construction Committee and for the designation of Guayabo Historic Site as Engineering Landmark for the World; AMCHAM, American Chamber of Commerce, Founder and President of the Social Responsibility Committee. Former Chair of the Environmental Committee. Founder member and ex-President of the Environmental Committee. Member of the National Committee on CSR; CADEXCO, Chamber of Costa Rican Exporters, consultant and advisor; International Life Cycle Initiative, UNEP SETAC, Board Member since foundation. She was in charge of the Environmental Impact Evaluation for the INTEL project in Costa Rica coordinating the effort of more than a dozen of national specialist on this assignment and more that 25 supporting personnel. Was the technical expert opinion for valuation of the Santa Elena Property (15,000 has of conservation land), the largest expropriation process for conservation in Costa Rica. Advises private and government sector clients on the development of environmental policies for implementation of EMS following international standards, including LC Thinking for decision making. Was the first and for several years the sole representative and Head of Delegation for Costa Rica at the ISO TC-207 actively participating at the EcoLabeling and Life Cycle Subcommittees. the Climate Change and the Developing Countries Working Groups and the Spanish Translation Task Force and was part of the Chair Advisory Group of TC-207. Was the founder of the Costa Rican mirror TC-207, being its president up to 2006. She was the only Latin American member of the Organizing Committee for International Panel on the Life Cycle Initiative promoted by UNEP and SET AC and has been, since the official launch an active member this international Initiative. She promoted and founded the Latin American Center for Life Cycle Assessment (ALCALA) and currently the Chair of the LATIN AMERICAN NET on LCA. She coordinated and executed the International Conference on LCA, for the first time in Latin America, CILCA 2005 realized in San Jose Costa Rica, now institutionalized as it has been realized also in Brazil (CILCA 2007) and Chile (CILCA 2009), and planned for Mexico (CILCA 20 II). Founded and presides the American Chamber of Commerce Committee on Social Responsibility. designed and for more than a decade has been part of the evaluation committee on the Community Service A ward offered to enterprises in Costa Rica. Is a registered advisor to the Chamber of Export in Costa Rica. Was in charge of the first local COM validation process (a unique experience for many years in Costa Rica) presented to ('ERUPT (Dutch government). Was in charge of the Evaluating Mission for the SIGA Project (Integrated System for Environmental Management in the Region of Central America), has trained more than one hundred auditors in EMS, QS and HSS, assisted dozens of private organizations in the development, implementation and certification/accreditation of EMS and QS. Currently has developed and is in the process of implementing an administrative system that assures transparency for both government and business enterprises. She is also working on several pilot projects, two that deal directly with LC applications, one with food sector polypropylene waste packaging material use (winner of the 2007 Community Service Award on all three areas as specialty for the SME category) and the other on education to foster more responsible consumption patterns and global citizenship in different classrooms around the world. other projects are related to waste management with emphasis on construction and household application. In addition is currently in charge of the pilot project for the Marrakech Task Force On Sustainable Public Procurment for Costa Rica. Chairs the Sustainable Construction Committees both for CIC and CFIA. Ms. Quiros is member of the board of directors of several organizations, gives lectures at higher-level education centers. publishes on a regular basis on magazines and newspapers and collaborates with UN and other organizations giving conferences and seminars on Commerce, Environment and Social Responsibility

Atsushi Inaba is a Professor at Kogakuin University, Japan. He graduated and got a doctor's degree in Chemical Engineering at the University of Tokyo, and then joined AIST in 1981 for the study of the development of coal liquefaction technology. He has been in charge of the evaluation study of CO2 mitigation technologies since 1986 and Life Cycle Assessment since 1993. He has research experience at National Bureau of Standards, MD, USA (1984-1986) and at International Institute for Applied Systems Analysis, Vienna, Austria.(1990-1992).

Dr. Inaba had led the activities related to LCA in Japan as the director of Research Center of LCA, AIST since 2001 to the end of March 2008, which is followed in the Research Institute of Science for Safety and Sustainability, AIST. He is also Professor of the University of Tokyo since 2005 to 2008. He moved to Kogakuin University on April 2009. He was one of co-chairs of ISO/TC207/SC5-WG6 (Re-edition of ISO-14040 series) in 2005-2007, and was a vice director in the first phase of the International Life Cycle Panel of UNEP/SETAC Life Cycle Initiative since 2002 to 2006. He is the recipient of the awards for innovative research of the Japan Petroleum Institute (1992) , the award of innovative research of the Japan Institute of Energy (1994), the award by the director general of the Science and Technology Agency(1998), and the award of the Japan Institute of Energy (2005) . He is a chair person of the project of Carbon Footprint of Products in Japan which is now on-going under leading of the Ministry of Economy, Trade and Industry. He is the expert and the chairman of the Japanese National Committee of ISO/TC207/SC5(LCA) and SC7-WG2(Carbon Footprint of Products).

Bas de Leeuw is Executive Director of Dana Meadows' Sustainability Institute, based in Hartland, Vermont, USA. The Institute applies systems thinking, system dynamics modeling, and organizational learning to economic, environmental and social challenges. Its C-ROADS model - Climate Rapid Overview and Decision-support Simulator - developed with researchers from MIT and with Ventana Systems, helps translate complex climate modelling into readily digestible predictions.

The Donella Meadows Leadership Fellows Program empowers and trains sustainability leaders from all over the world in the methods and tools of systems thinking and leadership. The core tools used are systems thinking, reflective conversation and vision. The research portfolio also includes projects on health and lifestyles. Before joining the Sustainability Institute, Bas was Head, Integrated Resource Management, of UNEP (United Nations Environment Programme), based in Paris (1998-2009). For UNEP he has initiated and managed programmes and initiatives such as Sustainable Consumption, Advertising Initiative, YouthXchange, UNEP/SETAC Life Cycle Initiative, Marrakech Process on a ten-year framework on Sustainable Consumption and Production, the UNEP/Wuppertal Institute Collaborative Centre on Sustainable Consumption and Production (CSCP), and he has set up the International Panel for Sustainable Resource Management (2007). He was acting chair of the International Life Cycle Panel (ILCP) and has represented UNEP in the Management and Policy Committee of the CSCP. Bas de Leeuw has also worked for the Dutch Government in several policy areas, including macro economic, energy and environmental policy planning (1985-1998). He has been seconded as a national expert to the OECD (2001), where he worked for the National Policies Division and drafted a report on "Policies to Promote Sustainable Consumption; An Overview", as part of the preparations for the World Summit for Sustainable Development (WSSD). Bas de Leeuw is an economist, with a master's degree in macro-economic policy from the Erasmus University Rotterdam, The Netherlands.

Basudeb Chaudhuri is an Associate Professor of Economics, Université de Caen, CREM (Centre for Research in Economics and Management, UMR 6211), currently on lien as Director, Centre the Sciences Humaines, the Research Centre of the French External Affairs Ministry and CNRS in New Delhi. Earlier he worked as Vice-President, University of Caen, 2006-2007, France ; Research Fellow ,Centre de l'Inde et de l'Asie du Sud (Centre for Southa Asian Studies, UMR 8564 EHESS-CNRS), Paris and Research Associate, London School of Economics, 2002-2003.

Dr. Chaudhari earned his Ph.D. degree from University of Paris I Panthéon Sorbonne and Masters and Bachelors degrees from University of Calcutta, Presidency College, India. His National and International Expertise includes International University exchanges in the broad areas of Public Economics, International Development, Globalisation, and Human Resource Development. Expert for the European commission, for the Erasmus Mundus Exchange Programme, for media. Experience in the administration of education and research programmes.

Charles Mbohwa is an Associate Professor Lecturer in the Department of Quality and Operations Management at the University of Johannesburg. Previously he was a Senior Lecturer at the Department of Mechanical Engineering, University of Zimbabwe. He was recently a Fulbright Scholar visiting The Supply Chain and Logistics Institute at the School of Industrial and Systems Engineering, Georgia Institute of Technology, to create a new masters course in Supply Chain Management and to research on the adaptation of electronic supply chain systems to less industrialized countries.

Dr. Mbohwa graduated with a B. Sc. Honours in Mechanical Engineering from the University of Zimbabwe in 1986 and then worked for 5 years as a mechanical engineer/operations manager for the National Railways of Zimbabwe. He then completed a Masters in Operations Management and Manufacturing Systems from the University of Nottingham in 1991 after which he joined the University of Zimbabwe as a lecturer. He studied for his Ph.D at the Tokyo Metropolitan Institute of Technology in Japan from 2001 to 2004. He teaches Production and Operations Management and Food Production to undergraduate students. His research activities are in logistics, supply chain management, quality, operations management, life cycle assessment and bio-energy/fuel feasibility. He has general research interests in renewable energies and sustainability issues. He has published a book chapter and more than 60 papers in these areas.

Chen Sau Soon is working as Senior General Manager at the SIRIM Berhad, Malaysia. She possesses B. Sc. (Honours) in Chemistry from University Malaya, M. Sc. (Distinction) in Chemical Research from Imperial College, University of London and Ph. D. (Physical Chemistry) from Imperial College, University of London and also Graduate Certificate in International Management, (Petronas), University of Melbourne.

Dr. Soon's important affiliations are - Chartered Chemist (Royal Society of Chemistry, United Kingdom), Chartered Scientist (Science Council, United Kingdom), Associate member, Malaysian Institute of Chemistry, IUPAC Affiliate Membership and Member, AMPERE (Association of Microwave Power). She has vast and diverse professional experience that includes Environmental and Health Risk Assessment, Life Cycle Assessment, Chemical Safety Evaluation, Hazardous Waste Management, Waste Treatment Technologies, Recycling and Reuse Technologies, and Renewable Energy. Some of her awards include a Bronze Medal for SIRIM Supercetor (Oil and Grease Interceptor) Expo Science, Technology & Innovation in 2004 and Bintang Kesatria Mangku Negara (K.M.N.) – in 2006.

Claudia A. Peña Is Director Of Sustainability Research Centre Of Mining And Metallurgy (Cimm) And Chair Of The Life Cycle Assessment Program Of Cimm. She Has Degree In Chemical Engineering From University Of Chile And Master In Chemical Engineering From Katholieke Universiteit Leuven (Kul), Belgium.

Ms. Pena is Member of different working groups of the UNEP-SETAC LC Initiative 2002-2005; Member of Advisory Committees of UNEP such as metal stocks and flows of the SRM panel, and the UNEP-CEO Water Mandate Water Accounting Project, 2009, among others and Member of the Ecoinvent International Advisory Council 2009. HeR collaborative research include- Steady state and dynamic modelling and simulation of the mining and metallurgical processes of the copper primary production and by-products; The development of the conceptual engineering for decontaminating and recovery of valuable metals from the dust of the Teniente furnace of the copper refinery "Ventanas" of ENAMI. R&D Cooperation agreement of CIMM, the Ministry of Mining, ENAMI and JOGMEC from Japan. The Environmental Risk Assessment of metals. Financed by CIMM, ICA, National funds for science and technology; development of the LCA as a methodological tool to environmentally assessing the copper production process. CIMM - Universidad de Chile; identification of the future research needs in mining and environment, Financed by the Chilean Copper Commission; contribution to the "Definition Study on Life Cycle Impact Assessment". LCIA Working Group of UNEP SETAC LC Initiative; development of the study of LCA as a useful tool for governmental institutions related to mining activities. Financed by the Chilean Ministry of Mining; The contribution to the LCIA Task force Group 2 of UNEP-SETAC LC Initiativel development of the "LCA South American project for a sustainable mining production (PROSUL)". CIMM, Chile; University of Brasilia; University of Bahia, Brazil., Financed by CYTED; development of the LCI of the copper primary production. Financed by Biosigma-Codelco, CIMM T&S and the National Fund of Science and Technology (Fondef); The determination of the carbon footprint of copper primary production. She organized the 3rd international LCA conference of Latin America, CILCA 2009.

Guido Sonnemann is Programme Officer for Innovation and Life Cycle Management working with UNEP's Division of Technology Industry and Economics (DTIE), Sustainable Consumption and Production Branch in Paris. His tasks are within the topic areas of sustainable innovation and 3R (reduce, reuse, recycling) within the Integrated Resource Management Unit. He is coordinator of the Secretariat of the UNEP/ SETAC (Society for Environmental Toxicology and Chemistry) Life Cycle Initiative.

Dr. Sonnemann is co-chairing the working group on e-waste and also coordinator of and UNEP focal point for the Global e-Sustainability Initiative (GeSI). In addition, he has been involved from the early beginning in the set up of the International Panel for Sustainable Resources Management and initiated activities that promote a life cycle economy by being involved in the Steering Committee of the StEP (Solving the E-waste Problem) Initiative and developing several innovative projects in the area of integrated resource management. Guido Sonnemann holds a PhD in Chemical Engineering and has published a number of scientific articles in the area of risk assessment, life cycle assessment and industrial ecology.

Hongtao Wang is an associate Professor in College of Architecture and Environment, Sichuan University. He started research work on Eco-materials and Life Cycle Assessment (LCA) in 1994. In 2001, he worked in CML, Leiden University, as a visiting scholar. He has been working as project leader in several LCA related projects in China. Besides development of LCA software and database in China, his main research interests recent years also involve LCA application in different life cycle management tools, such as eco-design, type-III environmental declaration, cleaner production, etc.

Mr. Wang is the first place winner of UNEP/SETAC LCA AWARD for developing and emerging countries in 2009. He has been teaching LCA and Industrial Ecology for Chinese and foreign students in Sichuan University since 2002. Due to long-term research in LCA and sustainability field, he is familiar with and active in the national and international scientific community. In collaboration with UNEP/SETAC Life Cycle Initiative, he successfully founded and organized the first Chinese conference on Life Cycle Management (CLCM) in Chengdu. He is also the regional delegate to UNEP International Life Cycle Board. He is the contact person for technical issues in the Memorandum of Understanding (MoU) on the International Reference Life Cycle Data System (ILCD) between EU LCA Platform at EC JRC and China National Institute for Standardization.

Ian Colbeck is Professor of Environmental Science in the Interdisciplinary Centre for Environment and Society at the University of Essex, UK. He has Masters degrees from Imperial College and Oxford University and a PhD from Lancaster University. He joined the University of Essex in 1984 and has held numerous administrative posts including Head of Department (2001-2004) and Director of the iCES (2005-2008). He is currently course Director for the Masters in Environmental Governance.

Professor Colbeck has amassed over 30 years considerable research achievements and experience over a wide gamut of research interests but predominantly in the field of environmental science. He is author or co-author of more than 250 papers and editor of several books (Air pollution by photochemical oxidants, 1994; Physical and Chemical Properties of Aerosols, 1998; Pollution and Environmental Monitoring, 2004; Environmental chemistry of aerosols, 2008; Basics of Air Pollution Monitoring, 2009; Human Exposure to Pollutants via Dermal Absorption and Inhalation, 2010). His research is funded through grants, contracts and studentships from Research Councils, industry and government departments. He has participated in national and international projects (EUROTRAC, FP V [NICE, CADENOX, SUB-AERO, URBAN-AERO and URBAN-EXPOSURE] and VI [NANOCAP]). Current research is centred in three main areas: environmental health (indoor air, bioaerosols), environment-society interactions (eco-cultures, resilience) and natural resource management (waste and recycling, nanoparticles, agricultural practices). He is an adviser to both government and corporate sector on environmental issues. He is associate editor of Water, Air and Pollution and a member of the editorial board of Environmental Research Letters.

Jane Bare is a chemical engineer with 24 years of experience within the U.S. EPA. She is one of 14 recognized international experts on the United Nations Environment Program (UNEP) Society of Environmental Toxicology and Chemistry (SETAC) International Life Cycle Panel which is the governing body of the UNEP/SETAC Life Cycle Initiative. She has served on the US Green Building Council's Life Cycle Assessment (LCA) into Leadership in Energy and Environmental Design (LEED) working group.

Ms. Bare also served on the DuPont's biobased advisory group, the American Institute of Chemical Engineering's (AICHE's) Sustainability Metrics Working Group, the National Institute of Science and Technology's (NIST's) biobased advisory group, and numerous SETAC North America and SETAC Europe Life Cycle Impact Assessment (LCIA) working groups. She has organized and chaired three international special topic workshops on LCIA and was active in ISO 14042 (Life Cycle Impact Assessment) development. She is the developer of the US EPA's Tool for the Reduction and Assessment of Chemical and other environmental Impacts (TRACI) which has been distributed to over 25,000 users. TRACI has been selected and/or used by: the U.S. Green Building Council, the National Institute of Standards and Technology's BEES (Building for Environmental and Economic Sustainability), the U.S. Marine Corps' EKAT (Environmental Knowledge and Assessment Tool), Pre Consultants' SimaPro (software for LCA), PE Engineering's GaBi (software for LCA), NSF International/American National Standard NSF 140 – 2005 – Sustainable Carpet Assessment Draft Standard. Her TRACI research was recognized in April 2006 with the individual Gold Medal for Exceptional Service – the highest EPA honor award.

Masayuki Sagisaka is the Deputy Director, Research Institute of Science for Safety & Sustainability (RISS) and also Leader of Material & Energy Sustainability Assessment Group (MESA, National Institute of Advanced Industrial Science and Technology (AIST), Japan. He is a also Visiting faculty at University of Tsukuba and Waseda University. He has earned doctorate degree in Engineering aafter completion of his graduation from Waseda University, School of Science and Technology, Faculty of Mineral Resources Engineering.

Dr. Sagisaka's some of the earlier assignments are Deputy Director, Research Centre for Life Cycle Assessment at AIST, Chief, Energy Analysis Division, Energy Resources Department, National Institute for Resources and Environment (NIRE) and Research councillor, NIRE. and has been an Academic Visitor at Imperial Collage of Science, Technology and Medicine, University of London (UK. Dr. Sagisaka has a large number of publications to his credit including awarded Best Paper for the Journal of Japan Society for Safety Engineering (1993) and Best Presentation for 8th International Conference on Mining & Metallurgy (1988). Dr. Sagisaka's Areas of Research interst include Sustainability Assessment of Biomass Utilisation, Environmental Impacts Analysis for Mining, Materials Processing and Local Area Development by Life Cycle Assessment Methods, Energy Systems Analysis, Gas Diffusion and the Safety Measures, and Mine Safety Monitoring.

Sanjay Kumar is an officer of Indian Revenue Service and is presently working in the Government of India as Commissioner of Income Tax at Kolkata. He has work experience of over 22 years, largely in the area of tax administration, international trade, telecommunication regulations and fertilizer subsidy and investment. He has represented India for three years at the WTO in the TRIPS Council, the Committee of Trade and Environment, the SPS Committee and the TBT Committee.

Mr. Kumar has also represented India at the Convention of Biological Diversity, Stockholm Convention on Trade of Hazardous Substances, UNCTAD, UNEP, and been a resource person for UNCTAD (Geneva), UNEP (Kenya), UNECSAP (Bangkok) and WTO (Philippines). Since 2007, he has been Adjunct Faculty at the Duke University, USA for the course on Tax Analysis & Revenue Forecasting. He has also taught courses on Intellectual Property Rights at the Jadavpur University, the Allahabad University, the Mizoram University, and at the National Academy of Agricultural Research & Management (NAARM), Hyderabad. He has also been a guest faculty at the National Academy of Direct Taxes (NADT), Nagpur. Mr. Sanjay Kumar has also worked as Consultant to the Department of Fertilizers, Government of India, to DFID, the British Government for designing Impact Assessment System for its rainfed-farming projects in India, and to ICEF (Indo-Canadian Environmental facility) for evaluating a renewable energy technology project for its sustainability and replication. His recent publications are on environment sustainability, intellectual property rights, international trade, tax revenue forecasting, and telecom industry. He has Masters' degree in Economics, Mathematics and Physics. He was also awarded British Chevening/Gurukul Scholarship for Leadership and Excellence.

Subhas K. Sikdar is the Associate Director for Science for the National Risk Management Research Laboratory. As the Director of the Sustainable Technology Division until Jan 9, 2004, he was the primary spokesman of EPA's R&D on clean technologies and pollution prevention. He directed research, both intramural and extramural on tools and methods for pollution prevention, cleaner process technologies, and demonstration and verification of cleaner technologies.

Dr. Sikdar joined EPA in 1990 and before that he held managerial positions at the National Institute of Standards and Technology in Boulder, Colorado, and General Electric Corporate Research & Development Center in Schenectady, New York. Dr. Sikdar is a Fellow of the American Association for the Advancement of Science (AAAS), Fellow of the American Institute of Chemical Engineers, Honorary Fellow of the Indian Institute of Chemical Engineers, winner of five EPA bronze medals, an R&D 100 award (1990), AIChE's Larry Cecil Award for Environmental Chemical Engineering (2002) and Professional Achievement Award in sustainability (2008), and Distinguished Engineering Alumnus Awards from University of Calcutta and University of Arizona (2003). From 2002 to 2005, he was a member of the Board of Governors of the Council for Chemical Research (CCR) and of the Green Chemistry Institute, and the Chair of the Sustainable Engineering Forum from 2003-2005. For some years he has been championing the concepts and methods for clean products and processes through a continuing NATO Pilot Project which he founded. He is a current member of the Industrial Advisory Board of the University of Arizona's College of Engineering , the Department of Chemical and Environmental Engineering of the Illinois Institute of Technology, the Center for Sustainable Systems, the University of Michigan, and the Mascaro Sustainability Center of the University of Pittsburgh. Until 2006, Dr. Sikdar was the leader of the technical expert group for a Center of Excellence on Environmental Engineering and Hazardous Wastes composed of several universities in Thailand. He is the founder and the co-Editor-in-Chief of the international journal, Clean Technologies and Environmental Policy, published quarterly by Springer Verlag of Germany. Currently, he is the Chair of the Institute for Sustainability of AIChE. Dr. Sikdar has published more than 75 technical papers in reputed journals, has 23 U.S. patents, and has edited 13 books.

Tim Grant is a specialist in life cycle assessment (LCA) with thirteen years experience developing and applying LCA with a wide range of companies and organisations. He is the Director of Life Cycle Strategies Pty Ltd, an Adjunct Professor at RMIT University's Centre for Design, and an Adjunct Research Fellow with CSIRO Division of Marine and Atmospheric Research.

Mr. Grant was founding member and president of the Australian Life Cycle Assessment Society (ALCAS), and is chairman of the Technical Committee of the Australia Life Cycle Database Initiative (AUSLCI). He is a co-author of the book *Life Cycle Assessment: Practices Principles and Prospects* (CSIRO, 2009) and previously contributed to *Design + Environment: A Global Guide to Designing Greener Goods* (Greenleaf, 2001). Tim works across many different sectors in LCA including agriculture, energy, fuels, water products, buildings and waste management. In addition, he has worked on the development of LCA databases for Australia. He is also a member of the international editorial board and the Australian geographical editor for the ecoinvent LCA database.

Indira Gandhi Institute of Development Research (IGIDR)

IGIDR is an Advanced Research Institute of the Reserve Bank of India (RBI) and a Deemed University with A++ accreditation, located at Mumbai, India. It was conceptualised in mid-eighties by Dr. Manmohan Singh, the then Governor of RBI and present Prime Minister of India and inaugurated in December 1987 by Shri Rajiv Gandhi, the then Prime Minister of India. The institute, through its academic and research activities, focuses on various development issues of national and international importance.

Some of the major research and academic activities of the institute cover the following areas:

- environment and development - sustainable development, natural resource accounting, greenhouse effects and global negotiations.
- energy systems, technology and policies.
- poverty, employment and redistribution.
- macroeconomic, trade, monetary and fiscal policies
- agricultural and rural development.

industrial structure, conduct and performance.

To facilitate dissemination of its policy oriented research, the Institute encourages work in collaboration with government departments and international agencies. Some of the major assignments completed include those for international organizations such as UNCED, UNDP, UNEP, UNCTAD, ESCAP, the Asian Development Bank and the World Bank. Collaboration with Indian organizations includes the work for the Planning Commission, Ministry of Environment and Forests, Department of Energy, Ministry of Commerce, etc. In addition, the Institute frequently hosts national and international events such as conferences, seminars, workshops, training, etc.

The Institute also conducts M.Sc., M.Phil and Ph.D. programmes, which are designed to create professionals who are capable of conducting policy analysis, relating to national and global development issues, in a quantitative and inter-disciplinary manner.

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